

CR-170890

TECHNICAL NOTE

Lockheed *per memo. 1985*
Missiles & Space Company, Inc.
Huntsville Research & Engineering Center *SQT*

Contract	NAS8-32982	Date	30 June 1982	Doc.	LMSC-HREC TN D867570
Title	RESULTS OF TESTS OF K5NA AND A REVISED FORMULATION OF EPDM/CORK PATCH MATERIAL IN MSFC HOT GAS FACILITY				

BACKGROUND

During prelaunch procedures at Kennedy Space Center some of the EPDM TPS material was damaged on the Solid Rocket Booster stiffener stubs. Thiokol's preferred solution was to patch the damaged areas with a cork-filled epoxy patching compound. Before this was done, however, it was requested that this patching technique be checked out by testing it in the MSFC Hot Gas Facility.

Two tests were run in the HGF in late 1980. The results showed the patch material to be adequate as reported in Ref. 1. Since that time, Thiokol has changed the formulation of the cork-filled epoxy material and it became necessary to retest this concept to be sure that the new material is as good as or better than the original material. In addition to the revised formulation material, tests were also made using K5NA as the patch material.

TEST DESCRIPTION

Test Objectives: The objectives of the tests reported herein were to:
 (1) compare the thermal performance of the original and the new cork-filled epoxy formulations, and (2) compare the K5NA closeout material to these epoxy materials.

Material Specifications: The original material was designated by Thiokol as UF-3280. It contained 20 to 40 mesh cork. The new material was designated as UF-3288, and contained 40 to 80 mesh cork. The K5NA was the standard formulation and was made in-house at MSFC.

Test Description: Four models were tested. These all had 1/4 in. EPDM on a 3/8 in. steel plate approximately 2.8 in. high by 8.8 in. wide. Divots

(NASA-CR-170890) RESULTS OF TESTS OF K5NA
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 MATERIAL IN MSFC HOT GAS FACILITY, Lockheed
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were created in the EPDM with diameters of 5/8 in., 1.0 in. and 1.5 in. as seen in Fig. 1. Four thermocouples were attached to the backside of each model as seen in Fig. 1.

The models were mounted at 90 deg to the flow at a distance of 11.5 in. from the leading edge of the "dummy" panel used to mount it in the HGF. All models were run in Position 1 of the HGF. Calibration values were used from Ref. 1 on the same model configuration.

Two models were constructed using UF-3288 as the patch material. These were designated SREF 5 and SREF 6. Two additional models were constructed using K5NA as the patch material. These were designated SREF 7 and SREF 8.

Pretest and post-test thickness measurements were made at locations shown in Fig. 1.

A run time of 32.85 sec was planned for each test with a cutoff when any thermocouple reached 300 F. The 32.85 sec time was selected because this was the run time used in the tests of Ref. 1.

The required heat load for the cork patch area was furnished by Carl Eckhardt of Thiokol as 1630 Btu/ft² computed as follows for the stiffener web aft face:

- Ascent load = 1192.3 Btu/ft²
- Reentry load = 437.7 Btu/ft²
- Total load = 1630.0 Btu/ft²

The flight heating rates were quoted as:

- Ascent maximum rate without plume impingement = 17.5 Btu/ft²-sec
- Ascent maximum rate with plume impingement = 85.6 Btu/ft²-sec
- Reentry maximum rate = 35.8 Btu/ft²-sec

Success Criteria: It was decided to run these models for the same run time as the original material test and to base the performance comparison on recession. That is, if the new material had as much as or less recession than the original material then it would be considered as good as the original material.

Test Results: Table 1 lists the run numbers, model numbers and run times for each of the four tests.

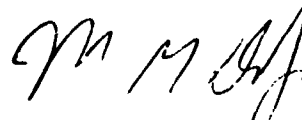
Tables 2 and 3 show the pretest and post-test thicknesses, and recession for each of the four models. These are then compared to the recession from the original material.

Figures 2 through 7 show typical pretest and post-test photos of these four models.

CONCLUSIONS:

As a result of these tests, the following conclusions were made:

- All three materials (UF-3280, UF-3288 and K5NA) will all meet the requirements.
- The UF-3288 is an improvement over the UF-3280 material.
- The K5NA is comparable to the UF-3288.



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Attach: (1) Tables 1 through 3
(2) Figs. 1 through 7

Ref. 1.: Dean, W.G., "Results of Tests of SRB Stiffener Stub EPDM/Cork Patch Technique in MSFC Hot Gas Facility," LMSC-HREC TN D784637, November 1981.

Table 1 - TEST RUN DATA

Run No.	Model No.	Date (1982)	Run Time (sec)
1112	SREF 5	5-5	32.84
1114	SREF 6	5-6	32.7
1138	SREF 7	5-18	32.95
1142	SREF 8	5-19	28.45*

* Cutoff on thermocouple on 3/8 in. steel not in area of K5NA.

Table 2 - RECESSION FROM UF-3288 AS COMPARED TO UF-3280

Model Location	Model SREF 5			Model SREF 6			Avg. Recession for Both Cork-Filled Epoxy Models (in.)	Recession from Previous Tests on UF-3280 (Ref. 1)
	Pretest Thickness (in.)	Post-Test Thickness (in.)	Recession (in.)	Pretest Thickness (in.)	Post-Test Thickness (in.)	Recession (in.)		
1	.730	.590	.140	.740	.660	.080	.110	.115
2	.730	.600	.130	.700	.660	.040	.085	.105
3	.730	.610	.100	.705	.670	.035	.077	.085

Table 3 - RECESSION FROM K5NA AS COMPARED TO UF-3280

Model Loc.	Model SREF 7			Model SREF 8				Avg. Recession for Both K5NA Models (in.)	Recession from Previous Test on UF-3280 (Ref. 1) (in.)
	Pretest Thickness (in.)	Post-Test Thickness (in.)	Recession (in.)	Pretest Thickness (in.)	Post-Test Thickness (in.)	Recession at 28.5 sec (in.)	Recession Extrapolated to 32.8 sec (in.)		
1	.716	.630	.086	.713	.645	.068	.078	.082	.115
2	.711	.650	.061	.720	.660	.060	.069	.065	.105
2	.728	.650	.078	.740	.665	.075	.086	.082	.085



Fig. 1 - Front View of Model SRFF-4, Showing Thermocouple and Thickness Measurement Locations

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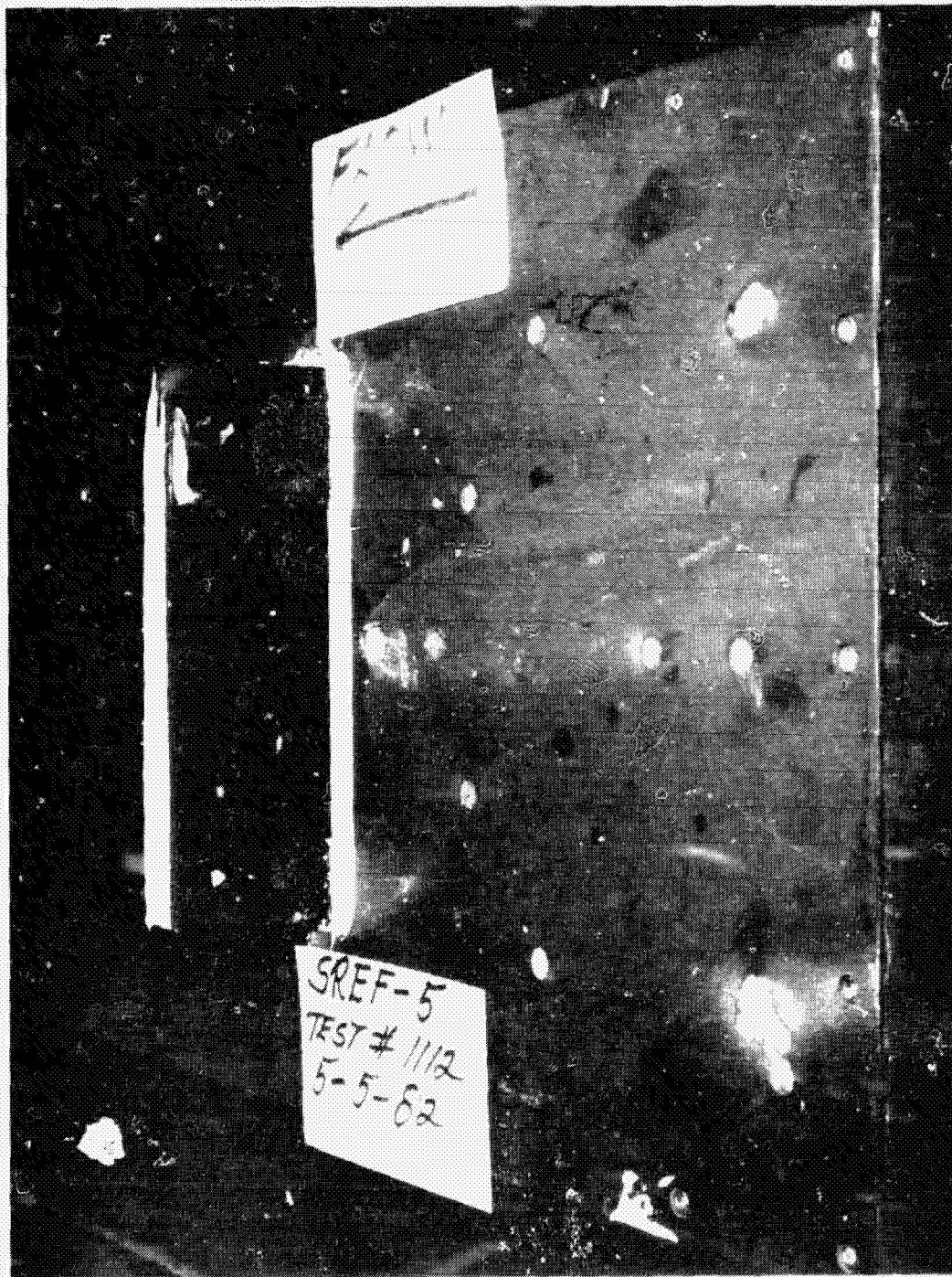


Fig. 2 - Pretest Photo of Model SREF-5

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Fig. 3 - Post-Test Photo of Model SREF-5

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Fig. 4 - Post-Test Photo of Model SREF-6

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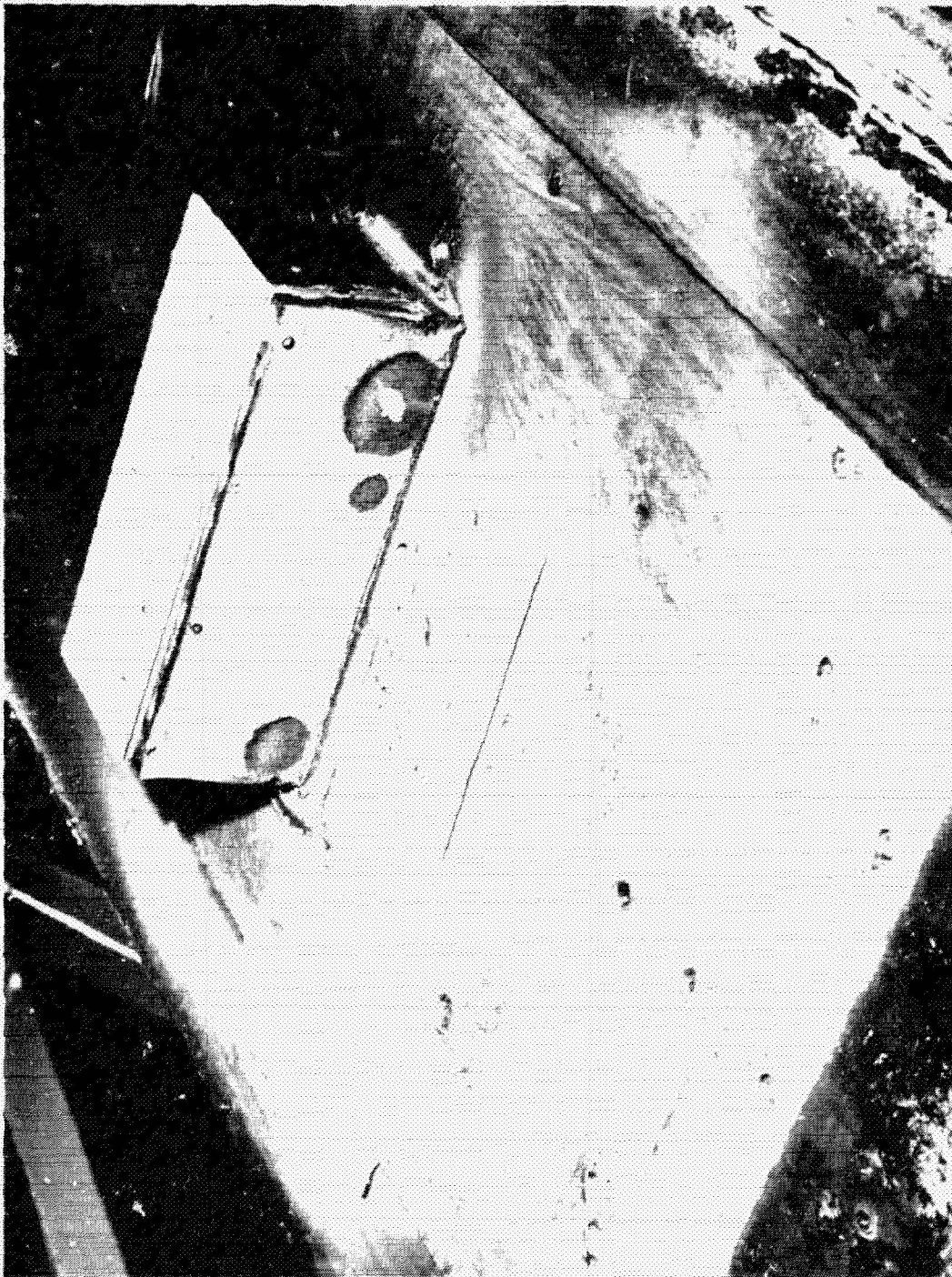


Fig. 5 - Post-Test Photo of Model SREF-7 (K5NA)

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Fig. 6 - Pretreatment of Model SREF-8

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Fig. 7 - Post-Test Photo of Model SREF-8